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Three Machine-Learning Algorithms Produce Various Allocations of Extrapolated Land Change

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I. Abstract

This study demonstrates how three machine-learning algorithms produce various allocations of extrapolated land change. Models from TerrSet’s Land Change Modeler (LCM) were used to compare the allocation of simulated change based on differences in algorithms. Weighted Normalized Likelihood (WNL), Support Vector Machine (SVM) and Multi-Layered Perceptron (MLP) were used to generate transition potentials. The models were calibrated with the reference change observed between 1938 and 2013 from the Long Term Ecological Research data of PIE. The calibration interval was extrapolated out to 2100 in two stages. WNL, MLP and SVM produced different allocated change while having the same calibration interval and driver variables because of the differences in their algorithms.

II. Data

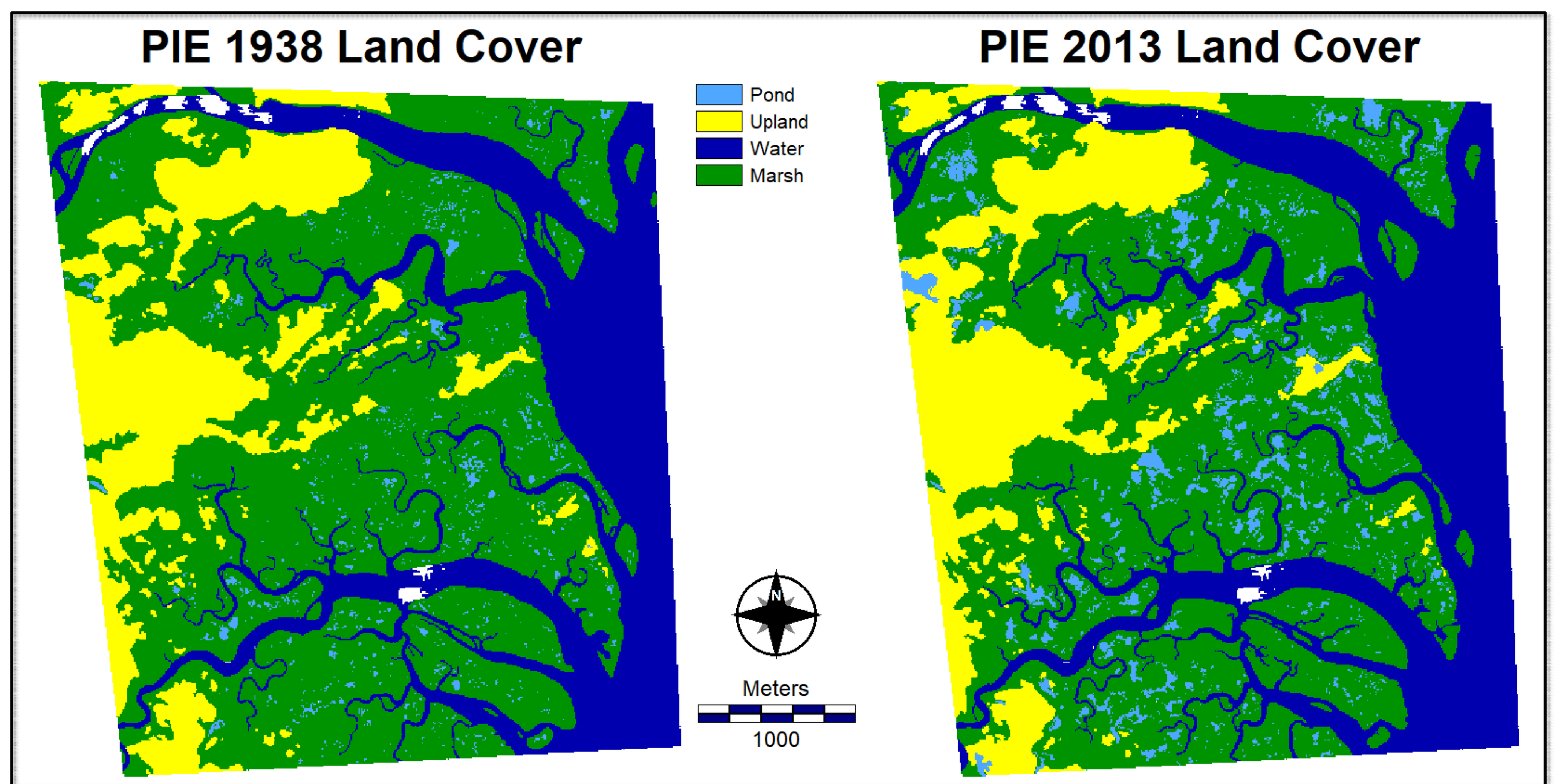

Fig 1 a-b: *Reference maps used to calibrate LCM.*

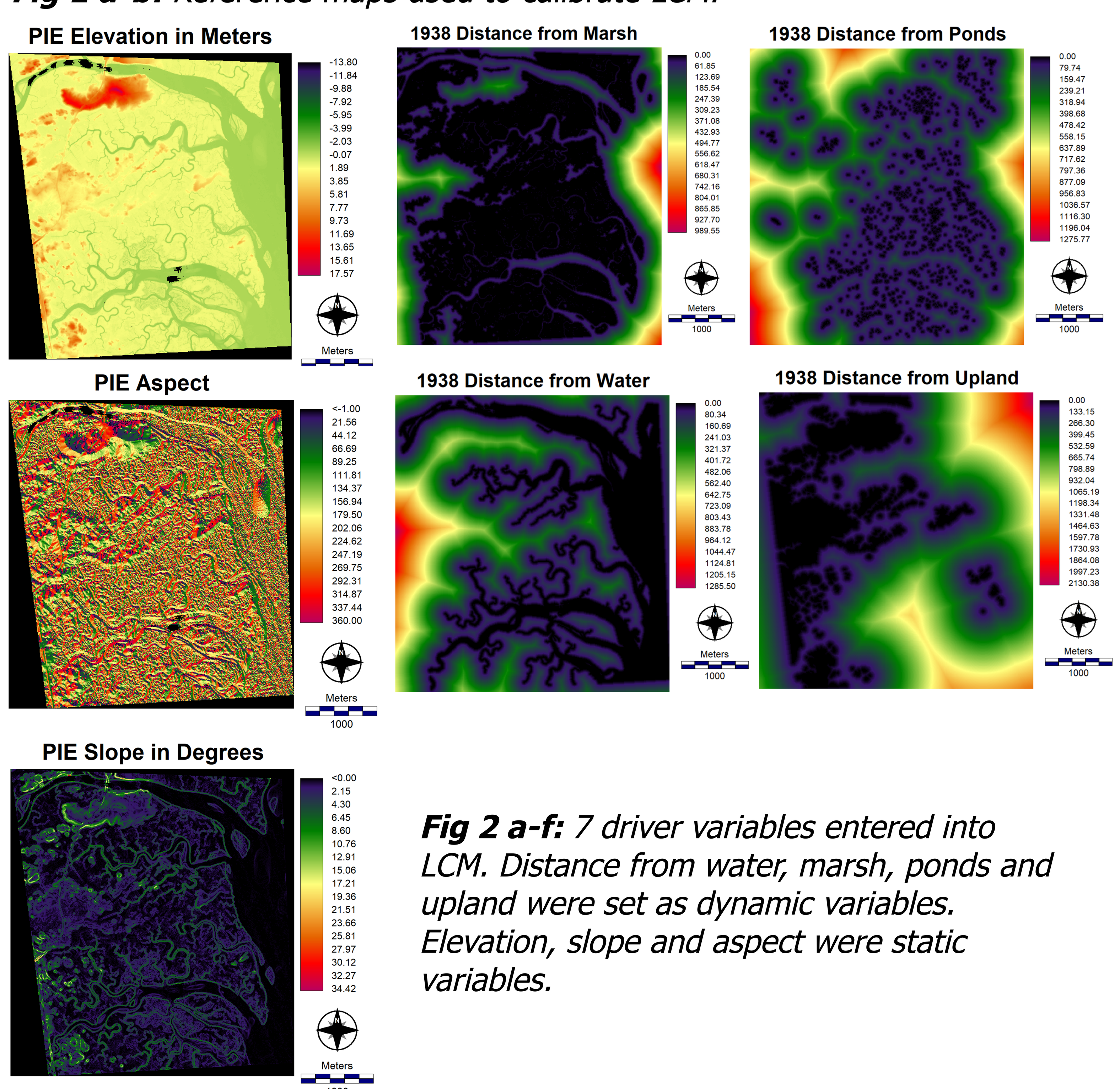

Fig 2 a-f: *7 driver variables entered into LCM. Distance from water, marsh, ponds and upland were set as dynamic variables. Elevation, slope and aspect were static variables.*

III. Model Results

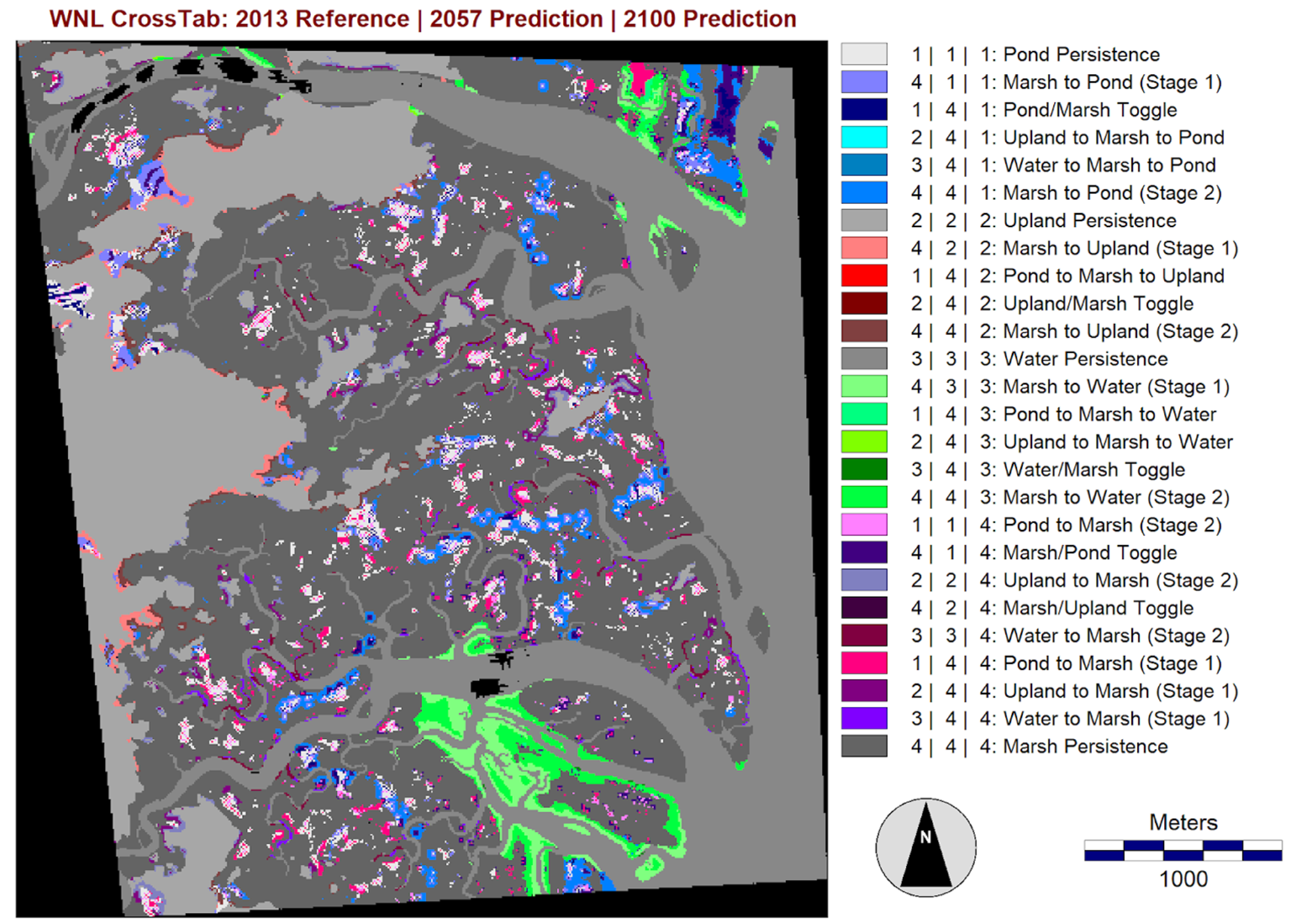

Fig 3: *Extrapolation to 2100 using Weighted Normalized Likelihood as the algorithm to generate transition potentials. Transitions to water are concentrated in the lower and upper right, shown in green clusters.*

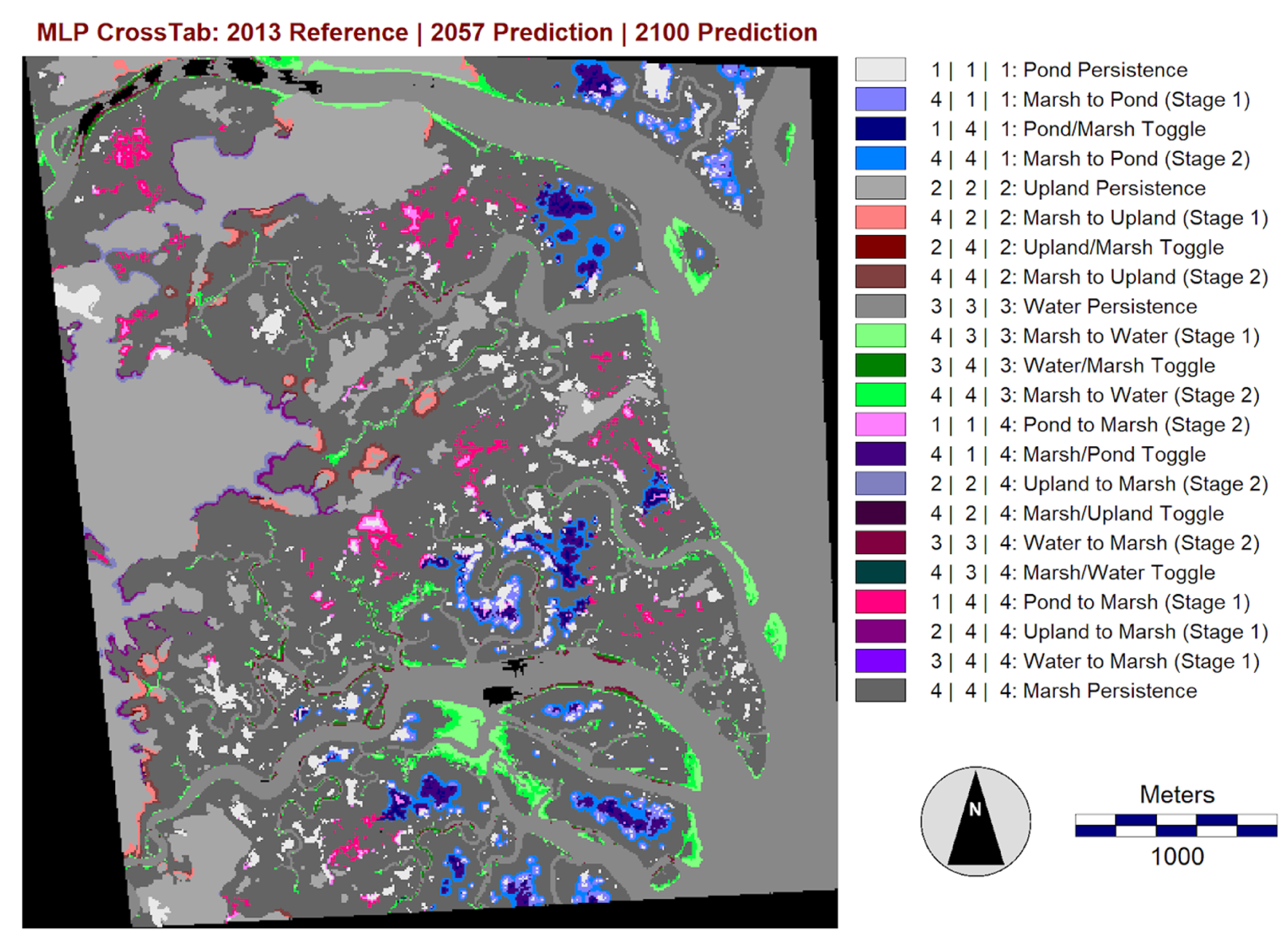

Fig 4: *LCM uses Multi-Layered Perceptron to develop the transition potential maps. Transitions to water are shown primarily along the coastlines with a sizable area representing water gain by 2100 in the lower sector. Transitions to ponds are shown in large clusters with the MLP algorithm, depicted in blue.*

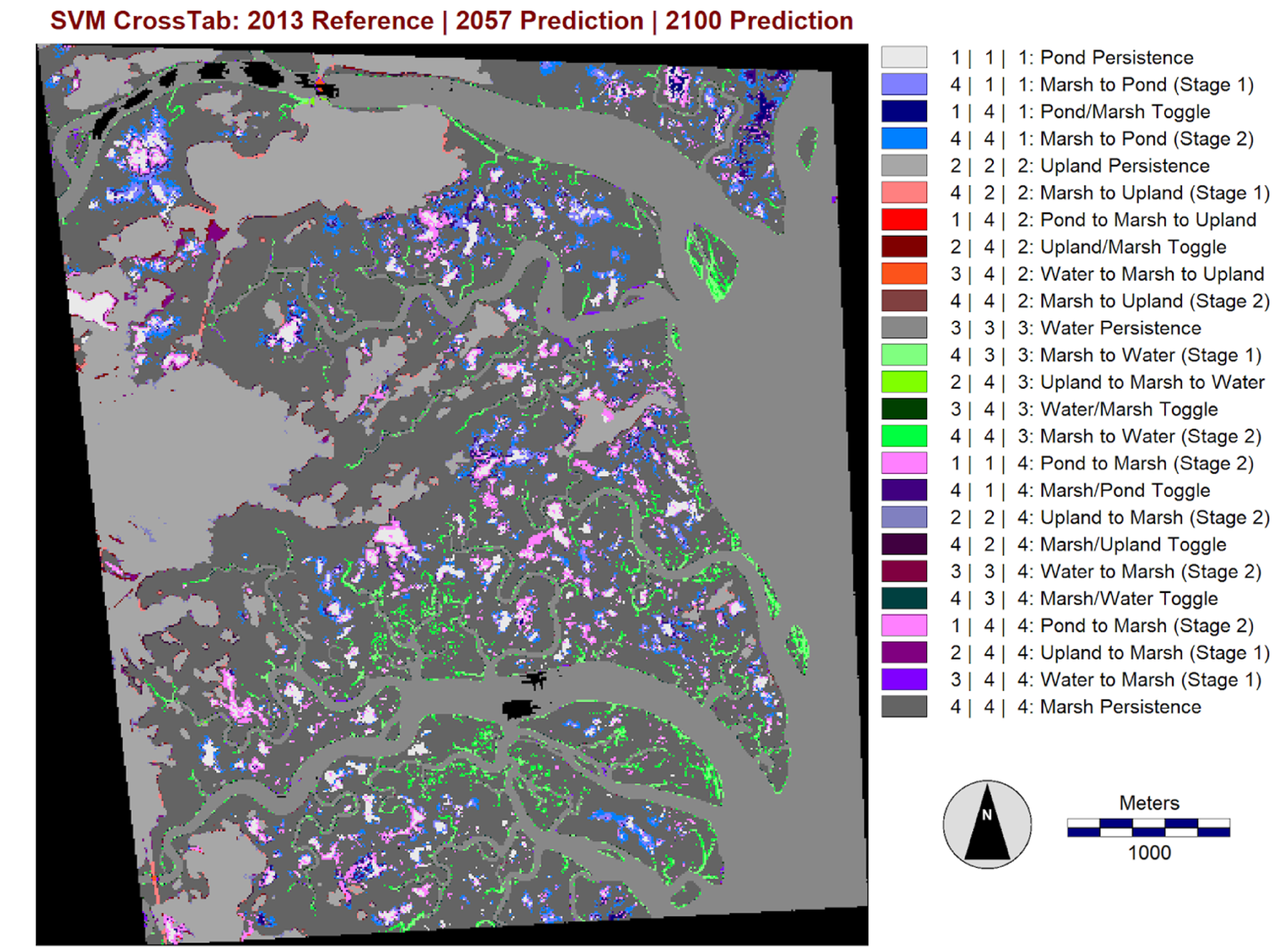

Fig 5: *Uses transition potentials generated with Support Vector Machine to extrapolate to 2100. The model shows simulated gains of water along borders where marsh and water meet and overall, there is less clustering of transitions with SVM.*

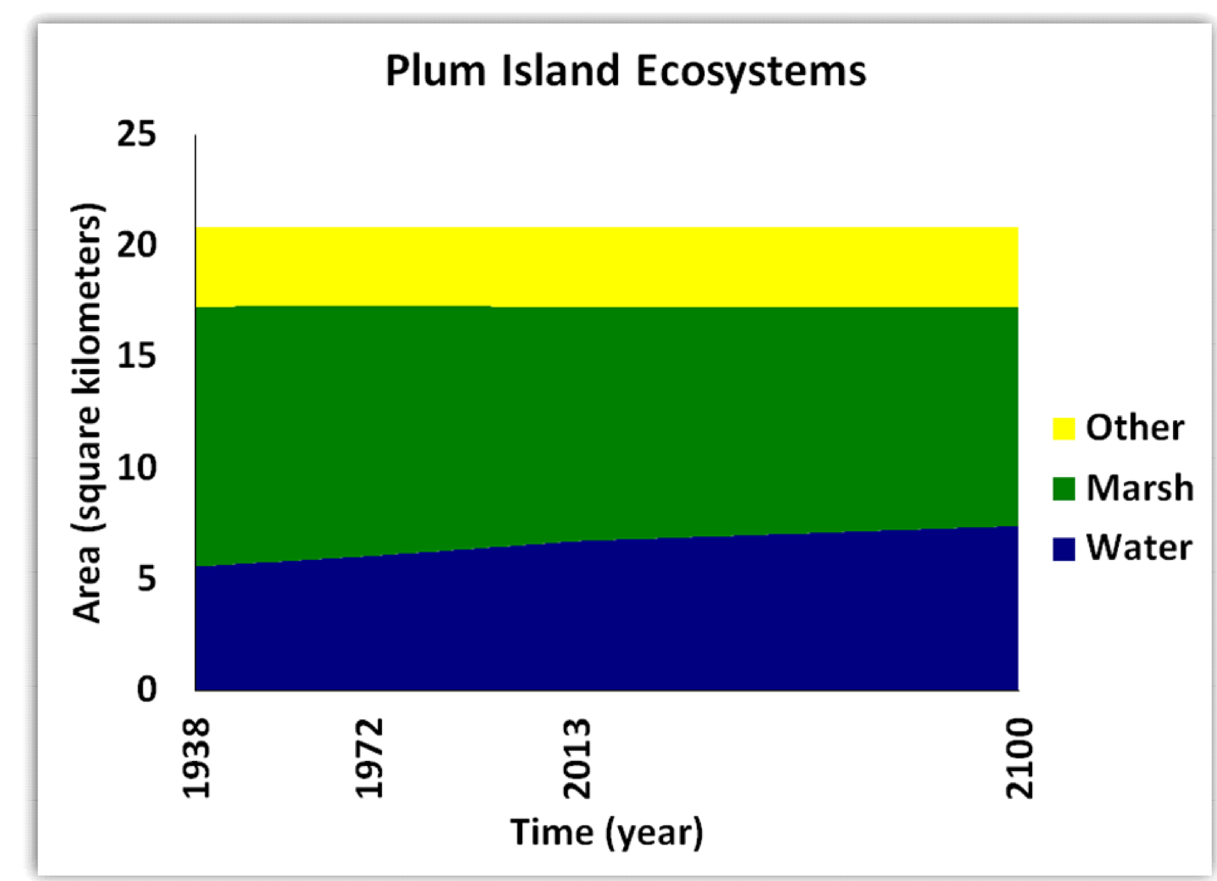

Fig 6: *Graphical representation of the simulated changes by 2100. WNL, MLP and SVM all extrapolate to 7.388 km^2 of water, 3.548 km^2 of upland and 9.876 km^2 of marsh by 2100. In this figure water contains calculations for ponds and other represents upland.*

IV. Conclusions

The three models MLP, SVM and WNL produce an identical quantity of simulated change because they utilize the same calibration interval and extrapolation point of 2100. Each algorithm creates a different allocation for where change occurred. This study demonstrates the variety of allocations possible within LCM for models using different algorithms to generate the transition potentials.

V. Acknowledgements

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